REMARKS

Claims 1-3, 5, 7-51 are pending in the application. Election of claims 1, 4-9 and 48-50 is affirmed; new claim 51 reads on Fig. 2.

Rejection under 35 U.S.C. 102

Claims 1, 4-6, 8, 9, 48, 49 stand rejected under 35 U.S.C. 102(b) as being anticipated by *Inagaki et al. (US 4,762,300)*.

Claim 1 as amended now defines a control device having at least one piezo element as a drive element arranged in the housing, wherein the at least one piezo element has a voltage-dependent stroke-force behavior. A piston is arranged in the housing. At least one pressure spring is arranged in the housing between the at least one piezo element and the piston, wherein the at least one piezo element acts through the at least one pressure spring on the piston. The at least one piezo element, based on the voltage-dependent stroke-force behavior, switches the piston into defined positions for controlling a flow of a pressure medium to a consumer, wherein the at least one pressure spring provides a switching means for moving the piston into the defined positions, respectively.

In the valve according to U.S. patent 4,762,300 the coil spring 282 (Fig. 2) acts only indirectly on the piston 18. The pressure spring 282 forces the valve ball 281 into its valve seat in the piston 18. When the piezo element 14 is excited, it must expand against the force of the spring 15. As described in col. 5, lines 42ff, the pressure medium that flows in via the inlet 32 forces the ball 281 against the spring force of spring 282 into its open position and the valve 28 opens. The pressure medium flows into the pressure chamber 16. When high voltage is supplied to it, the piezo element 14 extends so that the piston 13 that is directly connected to the piezo element 14 is moved against the force of the spring 15. In this way, the volume of the pressure chamber 16 is reduced. This causes the piston 18 in Fig. 2 to move to the right and the valve plug part 291 is lifted off the seat member 25. The pressure medium can flow out through the outlet 33 (arrow "OUT"). The described operation makes it clear that in contrast to the examiner's contention the pressure spring 282 has only the task of pressing the valve ball 281 into the valve seat so that this pressure spring 282 cannot serve to move the piston when the piezo element 14 is excited.

The spring 15 also does not have the task of transmitting the length change of the piezo element 14 onto the piston 18. Instead, the piezo element 14 together with the piston 13 seated directly on the piezo element 14 serves only to pressurize the pressure medium contained in the pressure chamber 16 by reducing the volume of the pressure chamber 16 and to move in this way the piston 18 in the described way. Accordingly, this configuration of the prior art cannot anticipate or make obvious the subject matter as claimed in claim 1.

The present invention as claimed in claim 5 provides piezo elements 12 that are arranged opposed to one another in the housing 1. The two piezo elements 12 act through a pressure spring 10, 11, respectively, on the ends of the piston 2, as shown in Fig. 2, so that the piezo elements 12 and the interposed piston 2 are arranged axially sequentially within the housing. The piezo elements 12 thus engage the same piston 2. Pressure springs are provided between the piston and the piezo elements, respectively, so that the piezo elements act through the pressure springs on the piston.

The Examiner argues that U.S. 4,762,300 shows in Fig. 6 a control device in which the piezo element and the corresponding piston are provided twice. Accordingly, there are two piezo elements as well as two pistons. In the disclosed prior art arrangement, the piezo elements act on two different pistons and the two pistons act in the same direction. This cannot anticipate or make obvious the claimed subject matter of claim 5.

Moreover, it is important in connection with the present invention that the two piezo elements 12 have a voltage-dependent stroke-force behavior. This means a behavior allowing a defined switching between individual positions. In the instant specification in connection with Fig. 2 (page 8, line 13, to page 9, line 16), it is explained in detail that the piston 2, depending on the excitation of the appropriate piezo element 12 is moved to the right or to the left. Accordingly, the work connector A or B is connected to the pressure connector P. In the center position of the piston 2, work connectors A, B are closed relative to the pressure connector P.

In the control device according to U.S. 4,762,300 high-voltage is applied to each piezo element (col. 2, lines 47-57). This high-voltage that is applied is proportional to the length extension of the piezo element. Accordingly, the control device is a proportional

valve and the piston is not switched between individual positions in a defined manner but, as a function of the applied voltage that creates a proportional length change, the piston is simply moved in accordance with the length change proportional to the voltage.

Claims 1 and 5 and therefore believed to be allowable.

Rejection under 35 U.S.C. 103

Claims 1, 4-9 and 48-50 stand rejected under 35 U.S.C. 103 (a) as being unpatentable over *Coleman (US 4,886,091)* and *Weber (US 5,911,245)*.

The cited patent U.S. 4,886,091 to *Coleman* shows DC solenoids being used instead of AC solenoids for an otherwise known valve. This is apparent when reading col. 1, lines 43ff. This prior art reference therefore discloses that at the end of the 1980s the USPTO considered a new drive mechanism for an otherwise known valve a sufficient feature for allowing a patent application.

Accordingly, employing piezo elements as a drive element in place of known drive elements in a valve should be sufficient in order to obtain a patent on a valve according to Fig. 4 of *Coleman*.

However, the cited prior art reference to *Coleman* cannot make obvious the present invention as claimed in claims 1 and 5, respectively. The two pressure springs 100,116 on both sides of the piston 92 are described in the cited patent as flexible drive members. In col. 1, line 65, to col. 2, line 5, it is disclosed in regard to these flexible drive members that the speed of movement of the actuator member and the speed of the movement of the valve component may be different. This is also disclosed in col. 2, lines 6-10, of *Coleman*. The springs 100, 116 are therefore damping elements. The efficiency of such known valves is reduced because within the electrical part of the valve energy must be expended for tensioning the springs 100,116. Decoupling of the elements as described is possible only because of the damping action of the springs.

Reference is being had also to col. 5, lines 51ff. According to this text portion, the speed of movement of the armature 114 compresses the flexible pressure spring 116 substantially but not completely when the armature 114 rests against the stop 115. Even though the spring 116 is tensioned, the piston 92 remains substantially at rest according to this disclosure. The pressure spring 116 thus stores the energy that has been exerted

on the pressure spring by armature 114. Accordingly, the springs 100, 116 have a completely different task than the springs of the present invention. According to the present invention, the pressure springs 10, 11 have the task of moving the piston 2 in the desired direction and into defined positions when the appropriate piezo element 12 is excited. The springs 100, 116 of *Coleman* cannot move the piston because the springs are compressed and act as damping means (col. 6, lines 3-7, of *Coleman* mentions also the damping function of the pressure springs 100, 116).

The springs 100,116 of *Coleman* are damping springs as discussed above. When the armatures 98,114 are moved, the damping springs 100, 116 are compressed without the piston 92 being moved. The armatures therefore do not act through the springs on the piston for moving the piston in a desired direction or into defined positions.

The secondary reference *U.S. 5,911, 245 (Weber)* shows a valve that has a piston 31 loaded on one side by the pressure spring 39. On the opposite end, a piston 41 engages the piston 31. The piston 41, according to col. 3, lines 1-7, is actuated by a solenoid 43 or a piezo drive.

According to the present invention, the piston 2 is acted on at both ends by the pressure springs 10, 11 (claim 5); the valve according to *U.S. 5,911,245* is provided only with one pressure spring 39.

A further difference resides in that the pressure spring 39 according to *U.S. 5,911,425* is not actuated by a piezo element; the piezo drive acts on the other side of the piston 31 and drives the piston 41 (instant claims 1 and 5).

Also, the pressure spring 39 of the secondary reference to *Weber* has a different function. The pressure spring 39 provides a pretensioning action and forces the piston 31 into an initial position (referred to in col. 2, lines 60ff, as the first position).

Coleman cannot provide a suggestion for solving the problem of the present invention. The object of the present invention is providing short switching times while providing a simple configuration. Such short switching times cannot be achieved, not even in approximation, by the known valve according to U.S. Coleman because of the damping springs 100,116; using piezo elements instead of the solenoids of *Coleman* would not change the damping function.

Coleman shows a valve where the springs 100, 116 are used for decoupling or damping. The spring 39 of U.S. 5,911, 245 (*Weber*) is used, on the other hand, for pretensioning the piston 31. The springs of these two known valves therefore have entirely different functions so that for this reason alone it is not obvious to combine these two teachings.

It is known to a person skilled in the art that piezo elements, despite pretensioning being provided, have only a minimal length extension. It is therefore desirable to employ a spring that has a progressive behavior. For this reason, a person skilled in the art would not employ damping springs 100,116 according to *Coleman* in a situation where very small length changes are to be expected anyway. It is therefore not obvious to employ an element that would normally be considered unsuitable by any technical developer.

The reference *U.S. 5,911,245* shows a configuration where the pressure spring 39 only serves as a pretensioning element with which the piston 31 is forced into an end position. Therefore, this prior art reference does not show the possibility that a piezo element switches a piston by means of an interposed pressure spring.

In view of the above, neither claim 1 nor claim 5 are obvious in view of the prior art combination *Coleman* and *Weber*.

The examiner has cited U.S. 3,799,203 (Doutt) as being of general interest. This reference describes a valve that operates with solenoids. Since these solenoids in comparison to piezo elements have relatively large stroke transmissions, again springs 15 are used as damping elements. According to col. 2, lines 38ff, the valve is supposed to withstand vibration and shake.

CONCLUSION

In view of the foregoing, it is submitted that this application is now in condition for allowance and such allowance is respectfully solicited.

Should the Examiner have any further objections or suggestions, the undersigned would appreciate a phone call or e-mail from the examiner to discuss appropriate amendments to place the application into condition for allowance.

Authorization is herewith given to charge any fees or any shortages in any fees required during prosecution of this application and not paid by other means to Patent and

Trademark Office deposit account 50-1199.

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